Regionalization of Post-Cardiac Arrest Care

David A. Pearson, MD, FACEP, FAAEM

Department of Emergency Medicine
I have no financial interest, arrangement, or affiliations and no commercial interests, ties, or grants related to material covered in this lecture.
Objectives - Regionalization

- Background
- Evidence: Code Cool™
- Best Practices
Variation in Survival VF arrest
Resuscitations Outcomes Consortium

Survival to discharge

- Vancouver: 25.0%
- Toronto: 15.7%
- Seattle: 39.9%
- Portland: 22.5%
- Pittsburgh: 21.5%
- Ottawa: 14.8%
- Milwaukee: 26.0%
- Iowa: 22.7%
- Dallas: 9.5%
- Alabama: 7.7%
### U.S. Implementation 2005

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Care (n=33)</td>
<td>29%</td>
<td>71%</td>
</tr>
<tr>
<td>Cardiology (n=64)</td>
<td>11%</td>
<td>89%</td>
</tr>
<tr>
<td>Emergency Medicine (n=109)</td>
<td>5%</td>
<td>95%</td>
</tr>
<tr>
<td>All respondents (n=263)</td>
<td>13%</td>
<td>87%</td>
</tr>
</tbody>
</table>

Regionalization Rationale

- IOM & AHA endorse regionalized systems
- Increase utilization of proven interventions
- Specialized resources at certain centers
- Correlation between case volume and patient outcome

1. Immediate recognition & activation of EMS

2. Early CPR - emphasis on chest compressions

3. Rapid defibrillation

4. Effective advanced life support

5. *Integrated post–cardiac arrest care*
AHA 2010: Post-Arrest Guidelines

- Optimize perfusion
- Identify & treat precipitating cause
- Transport to comprehensive post-cardiac arrest treatment system
  - Acute coronary interventions
  - Goal-directed critical care
  - Hypothermia
Transport to comprehensive post-cardiac arrest treatment center
Japanese Experience

- Second link (early defibrillation) most important
- Fifth link (multidisciplinary post-resuscitation care in a regional center) next most important
Minneapolis Experience

- 150 mile catchment area
- 140 out-of-hospital cardiac arrest patients
- ROSC < 60 minutes
- Included: any initial rhythm, HD instability, STEMI
- Excluded: DNR, active bleeding, comatose before arrest

Minneapolis Experience: Arrest Characteristics

- Witnessed: 82%
- Bystander CPR: 66%
- VT/VF 76%
- PEA/asystole 24%
- STEMI 49%
- Shock 44%
- Downtime 22 minutes
Minneapolis Experience: Outcomes

- 56% survived

- 51% good neurological outcome

- 20% increased risk of death with every hour delay in initiation of cooling

- Time to goal temperature not significantly associated with survival

**Minneapolis Heart Institute’s “Cool It”**

<table>
<thead>
<tr>
<th>Patient Group</th>
<th>Good Neurologic Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local (n=17/33)</td>
<td>42%</td>
</tr>
<tr>
<td>Referred/Transfer (n=58/107)</td>
<td>54%</td>
</tr>
<tr>
<td>Age &gt; 75 (n=9/30)</td>
<td>30%</td>
</tr>
<tr>
<td>Asystole/PEA (n=7/32)</td>
<td>22%</td>
</tr>
<tr>
<td>Downtime &gt; 30 min (n=16/45)</td>
<td>36%</td>
</tr>
</tbody>
</table>
CMC Experience

- Local: 46% good neurological outcome
- Referred: 39% good neurological outcome

Post-arrest resuscitation bundle

Fluid resuscitation via cold IVF

MAP > 70 mmHg

Therapeutic hypothermia

Avoid hyperoxia

Avoid hyperventilation
Code Cool Implementation Timeline

Nov-07
Code Cool Pathway Activation

Sep-08 - Jun-10
Regional Outreach Campaign

Nov-06 - Jul-07
Preparation and Planning
Post-Cardiac Arrest Resuscitation
Carolinas Medical Center CODE COOL™

For Code Cool Transfer, contact CMC Physician Connection Line (PCL)
704-512-7878, Toll Free 877-262-5337 or Yellow Phone

Inclusion Criteria
- Adults (age ≥ 18 years)
- Return of spontaneous circulation (ROSC) within 30 minutes of arrest
- Persistent coma, inability to follow commands and/or GCS ≤ 4

Exclusion Criteria
- Severe or terminal illness with anticipated non-aggressive care
- Active hemorrhage
- Systemic infection/sepsis
- Severe refractory shock

Resuscitation Priorities
- Airway: intubation
- Breathing
  - Avoid hyperventilation (goal PaCO2 of 30-40 mmHg)
  - Avoid hypocapnia (rapidly decrease PaCO2 to maintain SpO2 >95%)
- Circulation
  - Goal MAP >70
  - Anticoagulants and avoid hypotension
  - Norepinephrine is the preferred vasopressor
  - ECG screen for STEMI

Cooling Induction
- Initiate cooling as soon as possible after ROSC
- Refrigerated (38°C) IV N 30 ml/kg IV bolus (isotonic)
- Ice packs to groins, axilla, and neck
- Shivering control with Propofol to <5 µg/kg/min
- Paraburd with Vecuronium 0.1 mg/kg q1hr

Do
- Initiate transfer early
- Use paralytics during induction phase of cooling
- Document time of arrest, time of ROSC and neuro exam

Don't
- Delay cooling for CT scanning or autopsies testing before transfer, unless clinically indicated
Code Cool 2007-2012

- Started November 2007
- Total patients: 437 patients (Code Cool Protocol initiated)
- Total patients: 360 patients (Included in analysis)
- Transfers: 43%
- In-hospital arrests: 3%
- STEMIs: 9%
## Code Cool Demographics

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients (Completed protocol, included in analysis)</td>
<td>52</td>
<td>84</td>
<td>106</td>
</tr>
<tr>
<td>Transfers</td>
<td>23</td>
<td>36</td>
<td>50</td>
</tr>
<tr>
<td>In-patient arrests</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>STEMI</td>
<td>5</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>
Code Cool Outcomes: % Survival

% Survival

Survival
Survival with Good Neuro Status

Carolinatas Medical Center
Uncompromising Excellence. Commitment to Care.
## Survival and Initial Rhythm

<table>
<thead>
<tr>
<th>Initial Rhythm</th>
<th>2010 n=52</th>
<th>2011 n=84</th>
<th>2012 n=106</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survived</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VT/VF</td>
<td>57.6%</td>
<td>59.6%</td>
<td>56.1%</td>
</tr>
<tr>
<td>PEA</td>
<td>42.9%</td>
<td>33.3%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Asystole</td>
<td>20%</td>
<td>33.3%</td>
<td>16.7%</td>
</tr>
</tbody>
</table>
Code Cool Process: CMC Door to Target Temp Median Time
Code Cool Process Measures

- % Pts with Chilled IVF during induction
- % Pts with Paralytics
- % Pts with Initiation of cooling at transfer hospital

Year 2011  Q1 2012  Q2 2012  Q3 2012  Q4 2012
Code Cool Outcome: % Pts with Persistent Hypotension during 0-6 hours
ARE YOU READY TO SAVE MORE LIVES?
Regional Approach to Cardiovascular Emergencies

Cardiac Arrest Resuscitation System

Goal: To improve the survival from cardiac arrest by 50%
Hospital Response

Resuscitation-Capable Hospital

- Resuscitate
- Initiate cooling
- Transfer

Cardiac Arrest Center

- Hypothermia
- PCI
- ICD assessment & placement
Resuscitation-Capable Hospital

- ACLS protocols
- Baseline neurologic exam
- 2 large bore IV
- ECG = STEMI: activate STEMI plan
- Implement tx protocols for STEMI and cardiac arrest
Resuscitation-Capable Hospital

- Early notification of receiving hospital
- Early activation of transport plan
- Send medical records and EMTALA
Resuscitation-Capable Hospital

- Optimize BP to MAP > 80 mmHg
- Titrate EtCO2 for 35-40
- Consider CT imaging
- Induction of hypothermia (cold IVF)
- Sedation and paralysis
- Data measurement and feedback
Cardiac Arrest Center

- Ongoing neurological assessment & care
- Early coronary angiography if not a STEMI
- ICD evaluation
- 24/7 cath lab availability for STEMI
- Rehabilitation Plan
Hospital Response

Resuscitation Capable Hospital

- Resuscitate
- Initiate cooling
- Transfer

Cardiac Arrest Center

- Hypothermia
- PCI
- ICD assessment & placement
Take Home

- Aggressively resuscitate
- Establish transfer protocols
- Cardiac arrest centers
Questions?